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BULLETIN

(OF THE)

AMERICAN PHYSICAL SOCIETY.

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PROGRAMME OF THE

NEW YORK MEETING

AT

COLUMBIA UNIVERSITY

NEW YORK CITY

January 14–15, 1944

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The American Physical Society

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The President, Vice President, Secretary, Treasurer, Managing Editor, the three Past Presidents most recently retired from office, eight elected members and all Past Presidents first elected to the office of President prior to December 1932 constitute the Council which shall have general charge of the affairs of the Society.

Past Presidents now on Council: Henry Crew, Ernest Merritt, R. A. Millikan, Theodore Lyman, K. T. Compton, W. F. G. Swann, George B. Pegram, G. W. Stewart and P. W. Bridgman.

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JANUARY 14, 1944 Vol. 19, No. 1

BULLETIN

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NEW YORK MEETING, JANUARY 14–15, 1944

THE **259th meeting of the American Physical Society,** which is the "1943 Annual Meeting," is to be held at Columbia University in New York City on Friday and Saturday, January 14 and 15, 1944. The American Association of Physics Teachers (AAPT) holds meetings concurrent with ours, and we join it in its symposium. The Electron Microscope Society of America (EMSA) opens its career by holding its first meeting concurrently with ours. The distinction of their programmes is such, that the officers of the Physical Society have felt justified in arranging for no papers of our own, beyond the Retiring Presidential Address and the contributed ten-minute papers. Our registration desk will be set up and sessions will be held in the Pupin Physics Laboratories; so also in all probability will be the meetings of the other societies, except that EMSA will hold its Friday meetings in the Brander Matthews Theatre, 420 West 117th Street.

Hotel. The Hotel Pennsylvania (across the street from Pennsylvania Station) offers us single rooms at $3.85 and up, double rooms at $5.50 and up (twin beds at $6.60 and up). Reservations should be made immediately: in this year more than ever before, anyone arriving without a confirmed reservation takes a serious risk of not finding any room at all. Members should mention in writing that they belong to the Physical Society. Reminder is given that members expecting to arrive in the evening must so notify the hotel in making their reservations.

How to reach Columbia University (reprinted by request). To go from the Hotel Pennsylvania to the Pupin Laboratories proceed to the IRT subway (under the front entrance of the hotel), and take an uptown train marked either "B'way-7th Ave. Express—Van Cortlandt Park" or "B'way-7th Ave. Local—137th St." Get off at 116th Street, and walk three blocks north to 119th Street, turning there to the right through the campus gates. Allow 35 minutes. If on emerging from the subway at 116th Street you find yourself on Lenox Avenue, you have failed to follow the foregoing instructions, and should take a train in the reverse direction back to 96th Street and try again (it would, however, be quicker to take a taxi).

Contributed ten-minute papers will be given in two sessions, beginning on Friday morning at 10:15 and on Saturday afternoon at 2:30.

The **Business Meeting** of the Society will commence on Saturday morning at 10:15 in Room 301, Pupin Physics Laboratories.

The **retiring presidential address of President Hull,** "Physics in Industry," will be delivered in the same room: it will commence at the close of the Business Meeting or at 10:40 A.M., whichever moment comes the later. It will be followed by the two formal annual events of the AAPT: the award of the **Oersted Medal** to a distinguished teacher of physics whose name is yet to be disclosed, and the delivery of the (third) **Richtmyer Memorial Lecture** by Karl K. Darrow, with the title "The Future of Physics, Past and Present."

The joint symposium of the AAPT and the APS on *Training Programmes for Army and Navy Personnel in the Field of Physics* will be held on Friday afternoon in Room 301, Pupin Laboratories, commencing at 2:00. The speakers are Colonel H. Beukema, Mr. H. T. Briscoe, Lieutenant Commander A. C. Eurich, Dean H. L. Dodge. The title of Dean Dodge's paper is "The Physics War Front in Washington"; other titles are not yet available in the Society's office. Discussion will be led by R. B. Lindsay as to the Navy programme, by T. H. Osgood as to the Army programme. The discussion will be continued after the dinner if those in attendance so wish. Contributed papers on the programme of the AAPT will be given on Friday morning, also on Saturday afternoon if numerous enough, in Pupin 428.

The programme of the EMSA, consisting entirely of invited papers (to each of which fifteen minutes have been allotted for the reading of the paper and five minutes for discussion) is herein reproduced in full as a gesture of welcome to this newly-created Society. Inquiries about it should be directed to the secretary of the EMSA, M. C. Banca (address: Magnolia, New Jersey).

The dinner of the three societies will be held on Friday evening at six at the Men's Faculty Club, 400 West 117th Street (east of the campus) at a price of $1.50. Advance reservation, preferably by use of the form printed upon the inside back cover page of this Bulletin, is urgently advised. Places at the dinner cannot be guaranteed to anyone whose request for a reservation is not received by January thirteenth. Informal attire is recommended.

The Council of the American Physical Society will meet at 8 P.M. Thursday in the Men's Faculty Club of Columbia University. Members thereof who arrive in time will be welcome at dinner in the Club at 6:45.

The spring meeting of the American Physical Society will be held in Pittsburgh on April 27, 28, and 29, 1944.

The Metropolitan Section of the Society has adopted as its own meeting, at the gracious invitation of the Brooklyn Polytechnic Institute, the Symposium "Industrial Applications of X-Ray Diffraction" which that Institute is organizing for Friday evening, February 25 and Saturday, February 26 in its buildings. A programme of invited papers is already almost completely arranged: among the speakers are to be W. O. Baker, C. S. Barrett, J. D. H. Donnay, L. K. Frevel. Final announcements will be sent to all members of the Section, may or may not be distributed to others. Those desiring to become members of the Section should send their dues (one dollar) to its Secretary, W. S. Gorton, Bell Telephone Laboratories, Murray Hill, New Jersey.

General Rules Relating to Papers

By vote of the Society on December 27, 1940, no paper may be accepted for presentation at any meeting of the Society unless the title and an abstract of the paper are delivered to the office of the American Physical Society not later than the closing date stated in the printed call for the meeting.

The time allowed for the oral presentation of a contributed paper is ten minutes at most.

When two or more papers are contributed by the same member, all but one are placed on the "supplementary programme." (A paper by two or more members is credited to the one first named in its title.) For each paper on this programme the Secretary indicates a session at which it may be presented. The presiding officer at this session may call for it when the other papers are completed, may require that it be given in shortened form, or may read it by title.

Titles and abstracts of the papers to be presented are given in the following pages. Proofs of these abstracts have not been submitted to the authors. After submission of proof the abstracts will be published in an early number of *The Physical Review.*

KARL K. DARROW, *Secretary,*
American Physical Society,
Columbia University, New York 27, New York

PROGRAMME

Friday Morning at 10:15

Room 301 Pupin

A1. A Determination of the Rate of Production in Paraffin of Neutrons by the Cosmic Radiation at Sea Level. Max Kupferberg and S. A. Korff, *New York University.*—A determination of the rate of production in paraffin of neutrons by the cosmic radiation at sea level has been carried out. A large boron trifluoride counter was employed, 75 cm long and 14.6 cm in diameter. The counter was surrounded by about 50 cm of paraffin on all sides. Arrangement was made for surrounding the counter by a cadmium or a boron carbide shield. Counting rates unshielded and with each shield were obtained and the pulse size distribution was determined at several voltages by a biased diode skimmer. The difference in counting rates between the shielded and unshielded counter permits approximate evaluation of the rate of production of neutrons in the paraffin through the relations developed by Bethe, Korff, and Placzek. The counting rate produced by the neutrons was about nine per minute in this counter, which corresponds to a rate of production of about 2.4×10^{-5} neutron per gram of paraffin per second at sea level, if the capture cross section of paraffin for thermal neutrons is taken as 0.5×10^{-24} square cm, the rate of production being directly proportional to the paraffin capture figure.

A2. A Determination of Mesotron Mass-Lifetime Ratio by Correlation with Meteorological Data. K. Kupferberg and F. Reines, *New York University.*—A method is presented for correlating vertical mesotron intensity at a given elevation with atmospheric fluctuations to determine the rest mass to lifetime ratio. The analysis is based on the well-known equation for the decay of a radioactive particle. Previous methods of correcting daily mesotron intensity for variations of temperature and pressure at the instrument are insufficient, inasmuch as the distribution of air mass above the instrument is not taken into account. Our method of correcting for the daily variations is to correlate the mesotron intensity with the distance between the upper and lower limits of a selected pressure interval as determined by radiosonde measurements. Because of the dependence of lifetime on momentum, the expansion or contraction of the atmosphere affects most markedly those particles having lower momenta. As a result, the incremental mesotron spectrum can be reasonably replaced by a monoenergetic beam. A narrow-angle, wide-aperture telescope is under construction for the purpose of determining the angular distribution of mesotrons. With this information the analysis is applicable to such wide-angle devices as Millikan-type integrating electroscopes.

A3. The Quenching Mechanism in "Self-Quenching" Counters. S. A. Korff and R. D. Present.—The role of the polyatomic molecule in "quenching" the secondary emission by positive ions in a "self-quenching" Geiger-Mueller counter has been investigated. The polyatomic gas serves a twofold purpose: (1) quenching of ultraviolet photons and (2) quenching of secondary emission by positive ions reaching the cathode. The characteristic property of a polyatomic gas, which is of importance for the operation of a fast counter, is the large probability of predissociation from excited electronic states. The quenching of ultraviolet photons occurs through photodecomposition. In a fast counter containing a self-quenching mixture, the polyatomic gas has invariably a lower ionization potential than the monatomic constituent. The positive ions make 10^5 collisions in crossing the counter, and the electron transfer probability ensures that the positive ion sheath, when it reaches the cathode, is composed entirely of polyatomic ions. These are neutralized at about 10^{-7} cm from the wall and the excited neutral molecules predissociate in 10^{-13} sec. before they can liberate a secondary electron by an inelastic collision with the wall. This is why a polyatomic vapor counter needs no quenching resistance. We have performed experiments to test some of these points.

A4. Experiments on Large Cosmic-Ray Bursts in Relation to *A* Showers. R. E. Lapp and J. H. Alexander, *Ryerson Physical Laboratory, University of Chicago, Chicago, Illinois.*—Experiments on large cosmic-ray bursts in relation[1] to *A* showers (extensive atmospheric showers) are being continued. In line with the finding that at sea level large bursts in an unshielded ionization chamber (t_0 bursts) are coincident with *A* showers, the experiments have been extended by using two unshielded ionization chambers in coincidence with sets of Geiger-Mueller counters. In addition a further point on the transition curve for large bursts in iron has been investigated for a uniform 5-cm iron shield. The results show that a large fraction of the bursts under 5 cm of iron originate from *A* showers (t_0 bursts); the remaining fraction of the bursts is due to mesotrons (t_μ bursts).

[1] R. E. Lapp, Phys. Rev. **64**, 129 (1943).

A5. Auger Electrons Resulting from *K* Capture. Franklin Miller, Jr., *Rutgers University.*—The most intense group of Auger electrons due to x-rays associated with *K* capture in Zn^{65} would have energies lying in a narrow band within about 150 ev of 6850 ev ($H\rho$ 276 gauss-cm). These would arise from a K–L^2 transition in the resulting Cu atom. Electrons from the K–LM transition would be about $\frac{1}{3}$ as numerous, lying within 60 ev of 8000 ev ($H\rho$ 298). The soft electrons which are emitted copiously from Zn^{65} were found to have an absorption limit in collodion of 0.15 ± 0.03 mg/cm², approx. 7500 ev. When the samples were placed 0.6 to 1.3 cm from the screen of a screen wall

counter in a longitudinal magnetic field, filled with H_2 at 2-cm Hg pressure, the upper limit (by inspection) was found to be at $H\rho$ 300±30. Scattering in the counter gas and absorption in the sample are believed negligible. For an old sample of Fe, presumably Fe^{55}, as well as for a recent sample, soft electrons of $H\rho$ 220±30 were found. Theoretical values are $H\rho$ 237 (K–L^2) and $H\rho$ 252 (K–LM). There is some indication of a weaker group of electrons of about 20,000 ev max. energy from the recent Fe sample. These data are consistent with the hypothesis that the soft electrons from Zn^{65} and Fe^{55} are Auger electrons resulting from K capture.

A6. The Evaluation of the Intensities of Line Patterns Recorded on a Moving Film in its Application to the Measurement of X-Ray Intensities. J. C. M. BRENTANO AND H. FROULA, *Northwestern University.*—In evaluating the intensities of x-ray reflections recorded photographically as "lines" each line comprises a density distribution extending from a peak value to the density of the background. The evaluation of such a density range is unfavorable, particularly so when the distribution comprises a central band of high density which is narrow accompanied by a broader band in which the density "tails off" and when the latter represents an appreciable part of the total intensity. By rocking the photographic film during the exposure with uniform velocity in a direction normal to the lines a more even density distribution is obtained. When the range of rocking attains and exceeds the line width the density distribution shows flat plateaux. The intensities can then be assessed from the densities of these plateaux without requiring an evaluation of the range of uneven densities. A limitation arises where the permissible range of rocking is restricted by the closeness of the line pattern, but this limitation can be partially overcome.

A7. Thermionic Effects of Thin Films of Alkaline Earth Oxides on Metals. GEORGE E. MOORE AND H. W. ALLISON, *Bell Telephone Laboratories, Inc.*—Data are presented which indicate that approximately 0.001 monomolecular layer of alkaline earth oxide adsorbed on tungsten or molybdenum filaments produces optimum thermionic emission which is approximately the equivalent of that obtained with conventional oxide coated cathodes, using the same oxide. An effort was made to eliminate the effects of free alkaline earth metal. It was found that the heats of adsorption of the oxides to either tungsten or molybdenum are equivalent to the heats of formation of stable compounds and are in the order BaO, SrO, CaO; and that for SrO (and probably for BaO) the tenacity of adsorption to the support metal is in the order Mo, W, Ta, Pt–Rh. The order of the thermionic emission is the same in the various systems investigated. The chemical activity of the oxides is in the same order. It is suggested that differences in the dipole characteristics of the three alkaline earth oxide molecules are responsible for the differences in thermionic emission, adsorption, and chemical activity. A theory involving oriented adsorption is proposed which appears to account for the observed phenomena. The work suggests possible modifications in existing theories of the oxide-coated cathode.

A8. Electric Birefringence of Colloidal Solutions. B. W. SAKMANN, *Lubrication Laboratory, Massachusetts Institute of Technology.*—Measurements of the electro-optical effect of colloidal solutions may lead to an understanding of the interaction between the micelles in an electric field. The double refraction of colloids in alternating electric fields of low frequency consists of a direct and an alternating part. Both components have been measured in monodisperse bentonite sols of various particle size in dependence of field strength, frequency of the applied field, temperature, and concentration of the solution. The dependence of the vibrating part of the birefringence on the different parameters investigated is in good agreement with existing theories. Likewise the direct component of the double refraction of sols of large particle size and small concentration can be explained by the orientation theory in a satisfactory way. However, the direct part of the birefringence of sols of small particle size and high concentration cannot be explained by the orientation of anisotropic particles in the electric field. Measurements of the concentration dependence of the electric birefringence of those solutions indicate that part of the double refraction is due to an interaction between the micelles.

FRIDAY MORNING AT 10:15

Brander Matthews Theatre, 420 West 117th Street

First Programme of the Electron Microscope Society of America

The Stanford Electron Microscope. L. MARTON, *Stanford University.*

A Dynamic Method of Correcting Spherical Aberrations in Electron Lenses. V. K. ZWORYKIN, E. G. RAMBERG, AND JAMES HILLIER, *RCA Laboratories.*

Investigations of Magnetic Lenses. L. MARTON AND R. G. E. HUTTER, *Stanford University.*

(Title not yet available). C. H. BACHMAN, *General Electric Company.*

New Specimen Holders for Electron Microscopes. L. MARTON AND C. MARTON, *Stanford University.*

(Title not yet available). C. H. BACHMAN, *General Electric Company.*

Miscellaneous Research on Electron Microscope Parameters. JAMES HILLIER AND R. F. BAKER, *RCA Laboratories.*

FRIDAY AFTERNOON AT 2:00

Brander Matthews Theatre

Continuation of the Programme of the Electron Microscope Society of America

The Structure and Organization of the Bacterial Cell as Shown by Electron Microscopy. STUART MUDD, T. F. ANDERSON, AND KATHERINE POLEVITZKY, *University of Pennsylvania.*

A Discussion of Techniques in the Preparation of Biological Specimens for Electron Microscopy. THOMAS F. ANDERSON, *University of Pennsylvania.*

Electron Microscopy of the Etiological Agent of Lymphocyte Choriomeningitis. GREGORY SHWARTZMAN, *Mount Sinai Hospital.*

The Effects of Sonic Vibration, Ultraviolet Light and *p*H on the Bacteriophage Virus. THOMAS F. ANDERSON, *University of Pennsylvania.*

Comparative Morphology of Bacteriophages Active Against Bacteria of Widely Different Families. GREGORY SHWARTZMAN, *Mount Sinai Hospital.*

Electron Microscope Study of Sperm, Phages, and Nucleo Proteins. G. L. CLARK AND MARTHA B. BAYLOR, *University of Illinois.*

Electron Microscopy of the Pleuro-pneumonia-like Group of Micro-organisms. GREGORY SHWARTZMAN, *Mount Sinai Hospital.*

Particle Size Distribution of the Swine Influenza Virus. DR. GORDON SHARP, A. R. TAYLOR, I. W. MCLEAN, JR., DOROTHY BEARD AND J. W. BEARD, *Duke Hospital, Duke University.*

The Correlation of Electron Microscope, X-Ray Diffraction and Polarized Light Data in the Interpretation of Fiber Ultrastructure. FRANCIS O. SCHMITT AND CECIL E. HALL, *Massachusetts Institute of Technology.*

FRIDAY AFTERNOON AT 2:00

Room 301 Pupin

Joint Symposium of the AAPT and the APS

Training Programmes for Army and Navy Personnel in the Field of Physics
(Details on page 4 of this Bulletin)

SATURDAY MORNING AT 10:15

Room 301 Pupin

Business Meeting of the American Physical Society

SATURDAY MORNING AT 10:40

Room 301 Pupin

Joint Session of APS and AAPT

Physics in Industry. A. W. HULL, *General Electric Company.* (Retiring Presidential Address of the American Physical Society.)

The Future of Physics, Past and Present. KARL K. DARROW, *Bell Telephone Laboratories.* (Third Richtmyer Memorial Lecture of the American Association of Physics Teachers.)

Presentation of the Oersted Medal of the American Association of Physics Teachers for notable contributions to the teaching of physics.

SATURDAY MORNING AT 10:15

Room 428, Pupin Physics Laboratories

Continuation of the Programme of the Electron Microscope Society of America

Electron Microradiographs of Light Metals and Alloys. G. L. CLARK AND ROBERT B. FISCHER, *University of Illinois.*

Surface Replicas and Quantitative Stereoscopy. R. D. HEIDENREICH AND L. A. MATHESON, *Dow Chemical Company.*

Evaluation of the Properties of Magnesium Oxide from Electron Micrographs. G. L. CLARK, JOHN P. TORDELLA AND ROBERT B. FISCHER, *University of Illinois.*

Study of Collagenous Fibres. CHARLES J. BURTON AND R. BOWLING BARNES, *American Cyanamid Company.*

Structure of Polystyrene and Other Film-Forming Materials. E. L. KROPA, C. J. BURTON, R. BOWLING BARNES, *American Cyanamid Company.*

Molecular Weights of High Polymers with the Electron Microscope. R. D. HEIDENREICH, *Dow Chemical Company.*

SATURDAY AFTERNOON AT 2:15

Room 329, Pupin Physics Laboratories

Conclusion of the Programme of the Electron Microscope Society of America

Twinning in Zinc Oxide. M. L. FULLER, *New Jersey Zinc Company.*

(Title not yet available). O. S. DUFFENDACK, *University of Michigan.*

(Title not yet available). C. H. BACHMAN, *General Electric Company.*

Electron Diffraction Patterns of Some Electronically Transparent Thin Films. ROBERT G. PICARD, *RCA Laboratories.*

A Discussion on Resolution. WILLIAM G. KINSINGER, *Hercules Powder Company.*

A Discussion. R. BOWLING BARNES, *American Cyanamid Company.*

SATURDAY AFTERNOON AT 2:30

Room 301 Pupin

B1. Free Vibrations of Aeolotropic Bodies. H. EKSTEIN, *Research Laboratory, Commercial Equipment Co., Kansas City, Missouri.*—An approximation method similar to the perturbation theory of quantum mechanics is used to obtain frequencies and modes of crystal vibrations. First, a set of functions is selected whose linear combinations can be expected to be similar to the solutions sought. These functions are then subjected to a perturbation calculus which leads to a secular determinant of the usual form. The characteristic values of the secular equation give the frequencies. The method is applied to the extensional vibrations of thin rectangular plates. The zero-order solutions are rigorous solutions for the case of a square isotropic plate with vanishing Poisson's ratio. The perturbation calculus yields the frequencies and modes for the general case of the aeolotropic rectangular plate. The calculated frequencies and modes are compared with observations found in the bibliography (resonant frequencies and lycopodium powder patterns of piezoelectrically excited quartz and tourmaline plates). The agreement is satisfactory.

B2. The Effect of Rate of Shear on the Viscosity of Oils. F. MORGAN AND M. MUSKAT, *Gulf Research and Development Company, Pittsburgh, Pennsylvania.*—In the design of machine bearings the viscosity of the lubricating oil is normally assumed to be independent of the rate of shear. Recently,[1] however, a report has appeared of experiments which have been interpreted as indicating that all oils are probably thixotropic plastics at values of viscosity times rate of shear above approximately 7000 dynes/cm^2. This assumption has been tested with various lubricants in a journal bearing having a ratio of radius to clearance of about 970. Temperatures were measured by thermocouples set flush with the bearing surface. For highly refined oils the apparent deviation from linearity of plots of coefficient

of friction against product of viscosity and rate of shear up to values of 20,000 can be readily accounted for by the measured elevation in lubricant temperature. However, large deviations, exceeding those due to temperature rise, result for oils containing appreciable quantities of normally thixotropic materials. The results therefore indicate that for conventional, well-refined lubricating oils, the viscosity is usually independent of rate of shear at least over the practical range of speeds. On the other hand, many high viscosity compounded oils do undoubtedly behave as thixotropic plastics.

[1] Ruth N. Weltmann, Ind. Eng. Chem., Anal. Ed. **15**, 424 (1943).

B3. A Method of Determining the Energies and Wave Functions in Solids. H. A. BETHE AND F. C. VON DER LAGE, *Cornell University.*—The method differs from that of Wigner-Seitz-Slater in two respects: (1) Proper linear combinations of the usual spherical harmonics of order l are first constructed so that the sought one-electron ψ_k satisfies the symmetry required of a ψ_k belonging to the k in reduced wave vector space. This permits effectively a larger number of terms in ψ with a reduction of labor. (2) The boundary conditions on the surfaces of the crystal cell are essentially satisfied at points other than the center of the faces *ei* at more representative points as dictated by a Shockley "empty lattice" test. The method was applied in determining the lower lying energy levels at the center and far corners of the sodium k space. The results indicate that width of the first and second Brillouin zones along the (1, 0, 0) direction differs from the free electron approximation by about 4 percent. This is in marked contrast to Slater's result of about 50 percent. On the other hand the empty lattice test made upon two energy levels by Von der Lage and five by Bowers all yielded agreement within less than 1 percent of the known free electron energies.

B4. Kinematical Probability. BENJAMIN LIEBOWITZ, *Trubenizing Process Corporations, New York.*—As an inversion of quantum-mechanical ideas, a calculus is proposed in which the *density of solutions* P_a of a differential equation is sought rather than the solutions themselves. Thus, if a is a constant whose values are all equally probable, and $\delta\sigma$ is the normal distance between neighboring solutions $y(x, a)$ and $y(x, a+\delta a)$ of $y'=F(x, y)$, then by definition $P_a=|\delta a/\delta\sigma|=|(1+y'^2)^{\frac{1}{2}}/(\partial y/\partial a)|$. Alternatively, P_a is defined by means of the ratio of lengths cut by a sheaf of solutions from neighboring orthogonal trajectories. Let $1/R_\sigma$ be the curvature of these trajectories and s the length measured along a solution; then $d\log P_a/ds=-1/R_\sigma$. Similarly we define *orbital density* for a particle by means of the ratio of areas cut by a sheaf of orbits from neighboring action surfaces, $W(x, y, z, t)=C$ and $W(x, y, z, t)=C+\delta C$ at $t=t_0$. Dividing this ratio by the momentum ratio yields the *kinematical probability* P which satisfies $\partial\log P/\partial n=-\nabla^2 W/p$ (dn parallel to momentum $\mathbf{p}=\nabla W$). Putting $W=\pm k\log\psi$ transforms this into $(k^2/p^2\psi)\nabla^2\psi=1-d\log P/d\log\psi$. If we make the assumption $\nabla\cdot p=\pm 2p^2/k$, then $P=\text{const.}\times\psi^2$ and $\nabla^2\psi+(p^2/k^2)\psi=0$. Some insight into the significance of this assumption is obtained from the fact that it has $\mathbf{p}=\frac{\mp k}{2}\cdot\frac{li+mj+nk}{lx+my+nz+f(t)}$ as a "plane" solution, to which the curl of an arbitrary angular momentum may be added.

B5. Exchange Forces Between Li^+ and He, and The Mobility of Li^+ in He. ROLAND MEYEROTT AND HENRY MARGENAU, *Yale University, New Haven, Connecticut.*—A calculation of the exchange force between Li^+ and He has been made with the use of a simple hydrogenic state function to represent the charge distribution of the ion. The force so obtained was added to that arising from the polarizability and the Van der Waals interaction between Li^+ and He. The result was then used to calculate the mobility of Li^+ in He gas. The theoretical value thus found, 19.4 cm²/sec. volt at a temperature of 18°C, is somewhat lower than the experimental one of 25.8 cm²/sec. volt, reported by Hoselitz.[1]

[1] K. Hoselitz, Proc. Roy. Soc. **A177**, 200 (1940).

B6. On the Application of Dirac's Method of Field-Quantization to the Problem of Emission of Low Frequency Photons. W. PAULI, *The Institute for Advanced Study* AND J. M. JAUCH, *Princeton University, Princeton, New Jersey.*—The bremstrahlung emitted by an electron in an external field of force can in general be treated according to the usual perturbation theory with respect to the small parameter e^2/hc. This is no longer the case for the emission of many photons with a small frequency and a given amount of total energy which is lost by the electron, because the total cross section for the deflection of the electron through a given angle turns out to be infinite in first approximation. A more rigorous treatment of this problem was given by Bloch and Nordsieck using a suitable canonical transformation. A closer investigation by Pauli and Fierz showed, however, that it is necessary to introduce an arbitrary cutting off by large frequencies of some integrals in order to obtain a satisfactory result. It was therefore interesting to apply to this problem the new formalism of Dirac[1] which avoids all divergencies by using negative energy photons in a hypothetical world. According to Dirac's physical interpretation of his formalism one has to compute the probability of an emission process, where no negative energy photon is emitted in order to obtain the probability of the emission of low frequency photons in the actual world, which is here considered. The result is, however, not satisfactory. It does not seem that the difficulty can be removed without arbitrary changes of the rules applied for the physical interpretation of Dirac's formalism.

[1] P. A. M. Dirac, Proc. Roy. Soc. **A180** 1 (1942). Compare also the report of W. Pauli, Rev. Mod. Phys. **15**, 175 (1943).

B7. Continuation of Experiments with the Magnetic Current. FELIX EHRENHAFT, *New York.*—Five independent facts: movement of particles in the homogeneous magnetic field, reversing their direction of movement with

the reversal of the field; the appearance of oxygen if the two ends of one piece of soft Swedish iron immersed in acidulated water are magnetized north and south; circulation of positively and negatively charged gas bubbles and solid bodies in the same plane around the constant magnetic field, reversing their direction of circulation with the reversal of the electric as well as the magnetic field; spiral tracks of particles upwards and downwards in the constant vertical magnetic field in gases as well as in liquids; the magnetization north or south of particles through illumination by a beam of light, have to be explained by the magnetic current. Stefan, Hertz, and Heaviside had the presentiment of magnetic currents. By adding the terms for the magnetic current to the equation of electrodynamics, (defining magnetism also by two constants—conductivity for magnetism and permeability), these equations become entirely symmetrical concerning H and E. The tracks of the same particle carrying simultaneously electric and magnetic charges moving with three degrees of freedom have to be investigated separately in the homogeneous electric and homogeneous magnetic field, and jointly with these fields parallel as well as perpendicular to each other. New experiments will be described in magnetolysis and electrolysis.

TO BE READ BY TITLE

T1. A Simplified Method of Plate Calibration for Analytical Spectroscopy. SAUL LEVY, *Carnegie-Illinois Steel Corporation, Gary Works.*—Theoretical considerations (Silberstein-Webb) as well as experiments lead to the conclusion that the sensitometric curves for pure silver bromide unsensitized photographic emulsions are represented closely by expressions with one parameter, of importance in determination of the relative intensities. This feature can be utilized for simplification of plate calibration by preparing permanent curves for different contrasts and using a pair of spectral lines of a stable intensity ratio (gamma-pair) for determining the proper calibration curve. This procedure involves the experimental determination of a calibration curve of one particular contrast value (basic calibration). The curves for other contrasf values, as measured with the gamma-pair ratio using the basic curve, can be obtained by changing the unit to abscissa according to the gamma-pair ratio. The transparencies (or the galvanometer deviations) can be projected on the log intensity axis and scales thus obtained used with the scales for concentration—log intensity relation (Owens). Since the true intensity ratios are of no importance in the analytical spectroscopy, the basic curve can be found, in absence of a step-weakener of known transparencies, by measuring the gamma-pair lines on several spectrograms on the same plate made with weakeners of unknown transparencies.

T2. The Tensile Strength of Water. ALLEN KING, *Dartmouth College, Hanover, New Hampshire.*—From experiment and theory the tensile strength of water has been assigned values within three ranges: 0–50, 150–300, and above 20,000 atmospheres. Independent evidence for the 150–300 atmosphere range is obtained from a study of the spore discharge mechanism of common ferns. Reasonable values for Young's modulus of the annular arc ($\sim 4 \times 10^{11}$ dynes/cm^2) and for the range of spores ($\sim$5 cm) are found, if the tensile strength of water is assumed to be about 200 atmospheres. The calculated range is 2–3 times observed maximum values; but, since the computations are based on an idealized model, the result is not unexpected. Ripe sporangia of Polypodiaceae also can be shown to have diameters not exceeding 16 and not less than 5.5 annular cell lengths. Measurements on several species lie well within these limits.

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(To be sent to Karl K. Darrow, American Physical Society, Columbia University New York 27, New York)

I EXPECT to attend the dinner of the American Physical Society at the Men's Faculty Club of Columbia University, 400 West 117th Street, at six o'clock on Friday evening, January 14, 1944. My party will consist of —— persons.